

FY17 Accomplishments
Testing Facilities and Capabilities at SWiFT, SNL

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1. The Scaled Wind Farm Technologies (SWiFT) facility operated by Sandia National Laboratories (SNL) has, in support of the Atmosphere to electrons (A2e) research program, acquired measurements of wind turbine wake dynamics under various atmospheric conditions and while interacting with a downstream wind turbine.

SNL researchers, in collaboration with National Renewable Energy Laboratory (NREL) researchers, installed a customized LIDAR system created by the Technical University of Denmark (DTU) in one of the SWiFT wind turbines (Figure 1) and operated that turbine with intentional yaw-versus-wind-direction misalignment to study the behavior of the turbine wake under numerous combinations of atmospheric conditions and turbine yaw offsets. The DTU-customized LIDAR provided detailed measurements of the wake's shape and location at many distances downwind of the turbine (Figure 2). These measurements will benefit wind energy researchers looking to understand wind turbine wake behavior and improve modeling and simulation of wake dynamics, including the "wake steering" affect that is observed when turbine yaw offset is controlled. During the test campaign, two SWiFT wind turbines were operated at the same time to observe the influence of the turbines on each other as the wake of the upwind turbine was observed sweeping over and interacting with the downwind turbine.



**Figure 1. DTU's custom LIDAR being installed in the rear door
of a SWiFT wind turbine to scan the turbine wake.**

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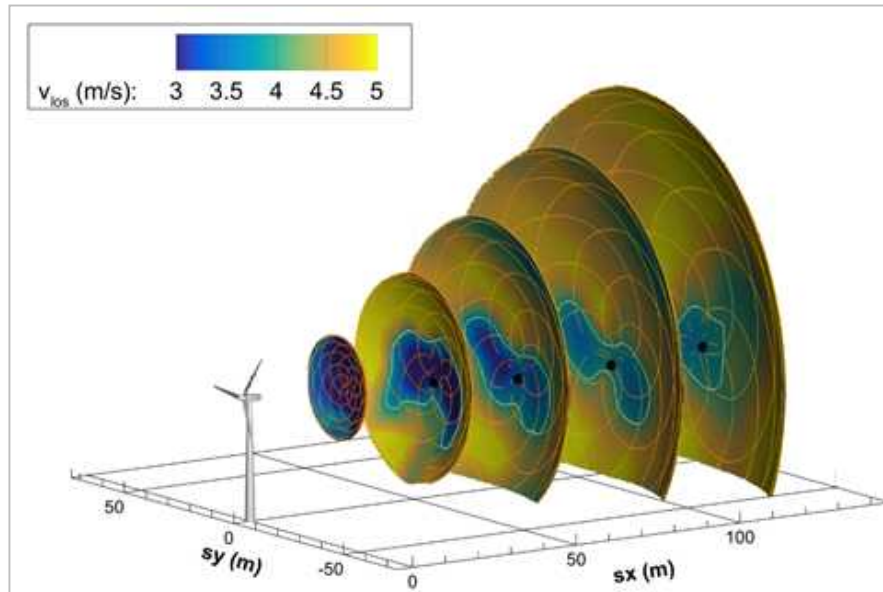


Figure 2. SWiFT turbine wake in unstable atmosphere scanned by DTU-customized LIDAR

2. SWiFT researchers temporarily installed a 4-beam LIDAR unit to operate simultaneously with DTU's custom wake-scanning LIDAR. The four point-measurements acquired by the simpler LIDAR unit will be compared and calibrated with the more detailed results acquired by DTU's LIDAR to prepare for future research applications of the 4-beam LIDAR unit.



Figure 3. Four-beam LIDAR installed for comparison with DTU LIDAR.

3. SWiFT has completed construction of and neared the end of commissioning activities for a turbine to replace the one that failed in 2014. Over the last three years, numerous safety and design improvements have been installed on all of the SWiFT wind turbines. Reconstruction and recommissioning of the failed turbine represents a major step forward in achieving the research capabilities envisioned from the beginning for SWiFT, including the ability to study the interaction between wind turbines.